

# New SFMR Processor Performance during 2022: Reduction of Invalid Flags in HDOBs

Ivan PopStefanija - ProSensing Inc.

Heather Holbach - FSU, NGI, NOAA/AOML/HRD



# SFMR Data Valid (DV) flag

## In-depth analysis of frequency of DV flag occurrence

---

SFMR Processor issues a DV flag in every %R message that is transmitted (broadcasted). Value of DV flag value "0" indicates that SFMR wind speed (SSWS) reported in the %R message is valid, and "1" indicates that the SFMR estimated SSWS is invalid.

65 flights with NOAA2 and NOAA3 operating the new SFMR processor conducted between June 27<sup>th</sup> and November 9<sup>th</sup>, 2022 were analyzed.

Removed all data samples collected over land, thus focusing our analysis on only data collected over ocean.

Total of SFMR samples (%R messages): 1,200,344

- at 1s rate total time of the record close to 14 days!!!

# SFMR Data Valid (DV) flag

## In-depth analysis of frequency of DV flag occurrence

---

Total of SFMR samples (%R messages): 1,200,344 (only over ocean!)

Number of samples with DV flag = "0" data valid: 1,110,494 (92.51%)

Number of samples with DV flag = "1" data invalid: 89,850 (7.49%)

Criteria causing DV flag = "1" invalid:

roll out of range:	76466	(6.37%)
pitch out of range:	1	(0.00%)
bad channel {< 3}:	63	(0.01%)

# SFMR RMS Error

## Wind-rain Algorithm Error

---



The RMS error represents a distance (averaged over six frequencies) between measured brightness temperature ( $T_b$ ) by the SFMR and the theoretical brightness temperature calculated using wind induced  $T_b$  ("Excess emissivity") empirical model.

In the new SFMR processor the estimate of the RMS error is normalized so that the RMS error value of 0.1 represents an error in SFMR wind speed estimate of  $\pm 5$  m/s – at any sea surface wind condition (from TD to CAT 5!).

Total number of SFMR valid wind estimates: 1,110,494

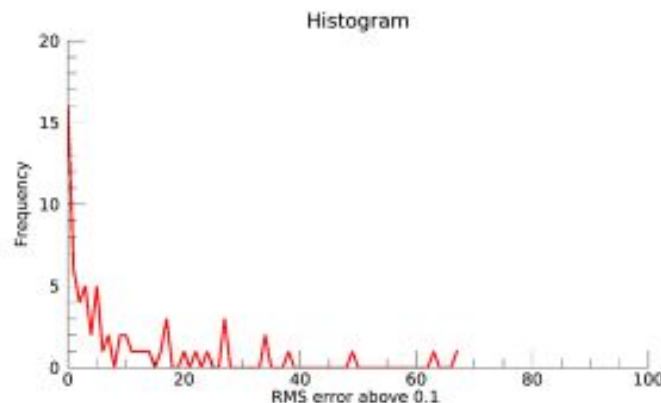
Reported to NOAA computers with DV flag = "0"

Total number of SFMR wind RMS error  $< 0.1$  | SSWS error  $< \pm 5$  m/s: 1,109,825 (99.94%)

Total number of SFMR wind RMS error  $> 0.1$  | SSWS error  $> \pm 5$  m/s: 669 (0.06%)

# SFMR RMS Error

## Wind-rain Algorithm Error

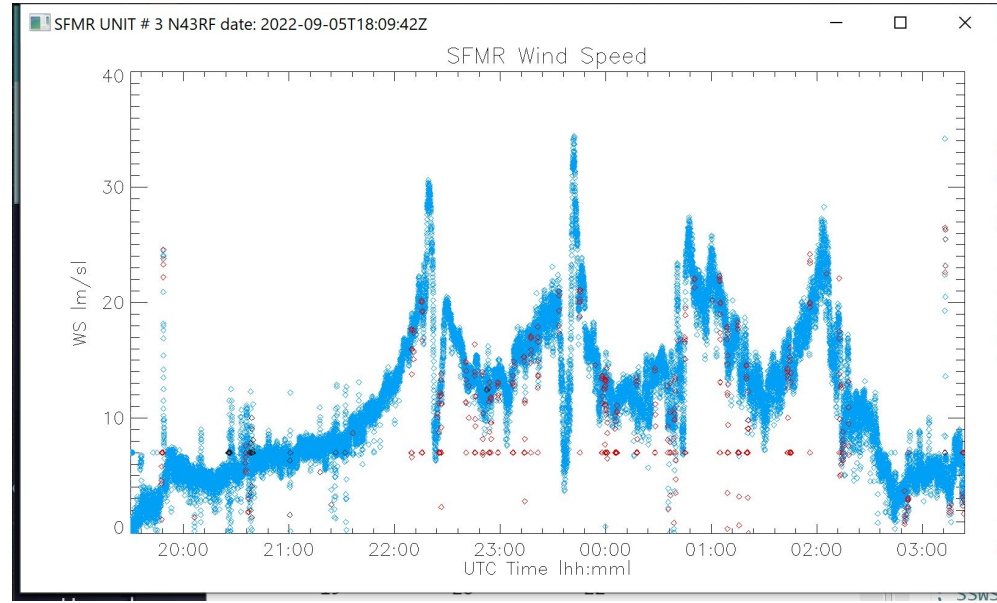
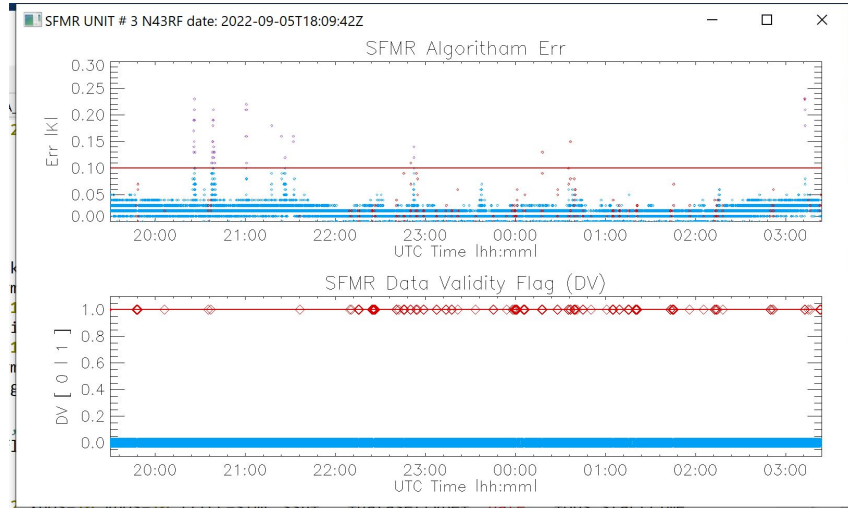


RMS error occurred more than 20 times on only 10 flights out of 65 flights processed.

Total number of RMS errors > 0.1 (SSWS > +/- 5 m/s) on those 10 flights: 388 (58 %).

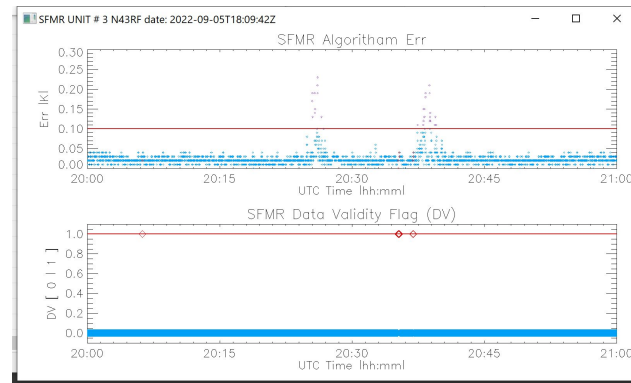
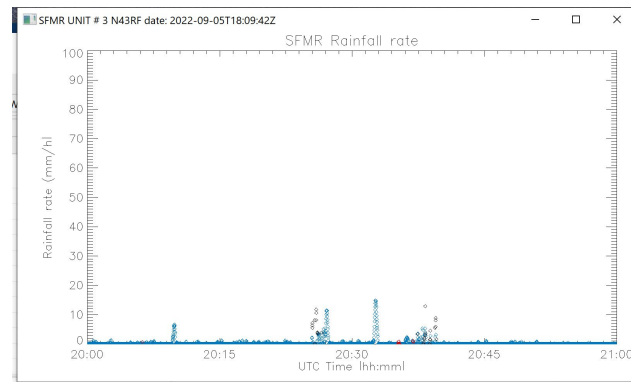
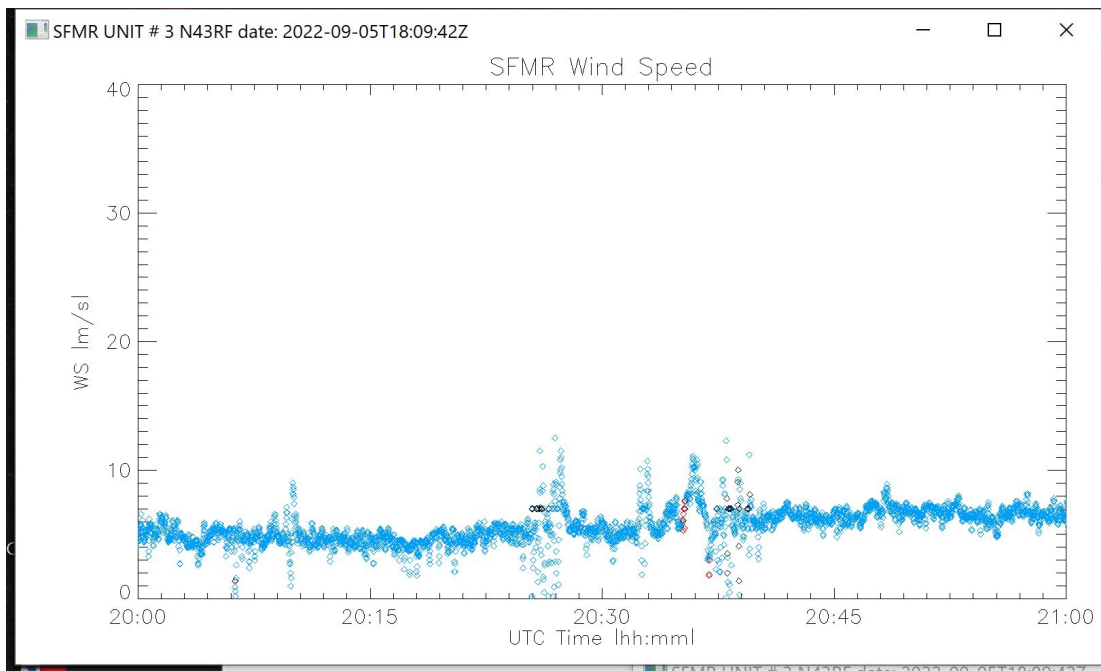
# SFMR RMS error wind-rain algorithm error

Flight ID: 20220905I1



# SFMR RMS error wind-rain algorithm error

Flight ID: 2022090511

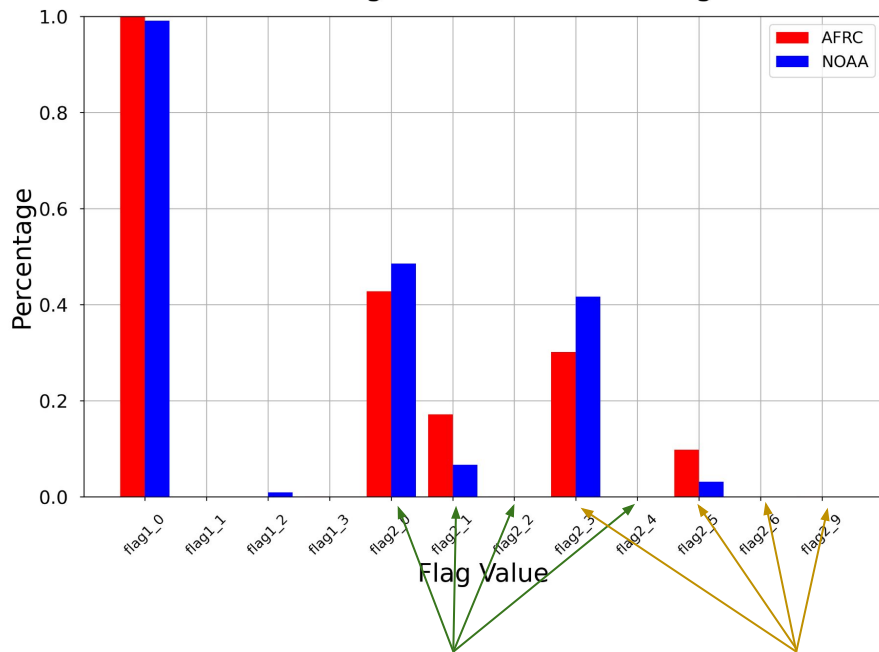


# HDOB Flagging

NOAA Good  
2021: 55.2%  
2022: 81.6%

NOAA Questionable  
2021: 44.8%  
2022: 18.4%

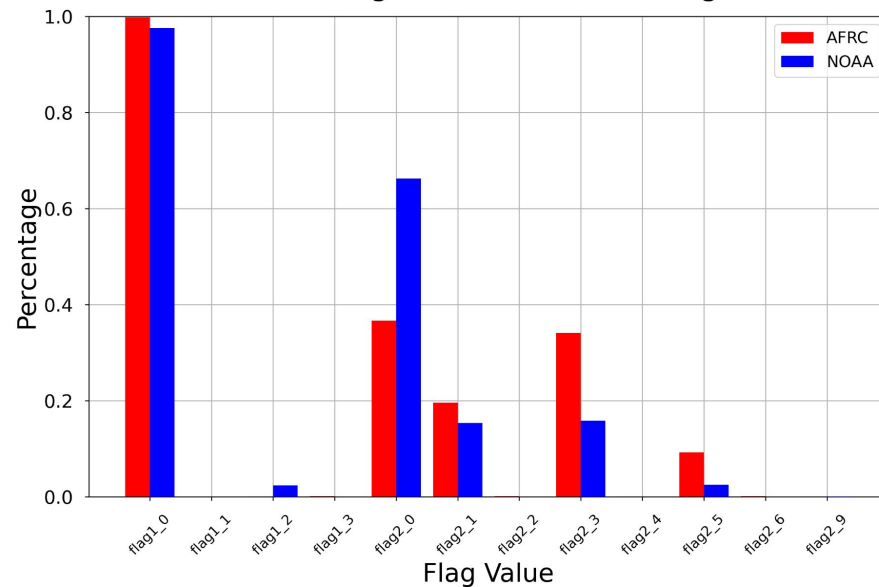
## 2021 Flag Occurrence Percentage



SFMR Good

SFMR Questionable

## 2022 Flag Occurrence Percentage



# Proposed Change to HDOB Flag

## Current Flag

First column indicates status of positional variables as follows:

- 0 All parameters of nominal accuracy
- 1 Lat/lon questionable
- 2 Geopotential altitude or static pressure questionable
- 3 Both lat/lon and GA/PS questionable

Second column indicates status of meteorological variables as follows:

- 0 All parameters of nominal accuracy
- 1 T or TD questionable
- 2 Flight-level winds questionable
- 3 SFM R parameter(s) questionable
- 4 T/TD and FL winds questionable
- 5 T/TD and SFMR questionable
- 6 FL winds and SFMR questionable
- 9 T/TD, FL winds, and SFMR questionable

## Option 1 (least change to existing)

First column:

- 0 All parameters of nominal accuracy
- 1 Lat/lon questionable
- 2 Geopotential altitude or static pressure questionable
- 3 SFMR shallow water
- 4 Lat/lon and GA/PS questionable
- 5 Lat/lon questionable and SFMR shallow water
- 6 GA/PS questionable and SFMR shallow water
- 9 Lat/lon and GA/PS questionable and SFMR shallow water

Second column:

Unchanged (possibly change SFMR questionable to SFMR reduced sample)

# Proposed Change to HDOB Flag

## Current Flag

First column indicates status of positional variables as follows:

- 0 All parameters of nominal accuracy
- 1 ~~Lat/lon questionable~~
- 2 Geopotential altitude or static pressure questionable
- 3 Both lat/lon and GA/PS questionable

Second column indicates status of meteorological variables as follows:

- 0 All parameters of nominal accuracy
- 1 T or TD questionable
- 2 Flight-level winds questionable
- 3 SFMR parameter(s) questionable
- 4 T/TD and FL winds questionable
- 5 T/TD and SFMR questionable
- 6 FL winds and SFMR questionable
- 9 T/TD, FL winds, and SFMR questionable

## Option 2 (recommended by SFMR group)

First column:

- 0 All parameters of nominal accuracy
- 1 T or TD questionable
- 2 Geopotential altitude or static pressure questionable
- 3 Flight-level winds questionable
- 4 T/TD and GA/PS questionable
- 5 T/TD and FL winds questionable
- 6 GA/PS and FL winds questionable
- 9 T/TD, GA/PS, and FL winds questionable

Second column:

- 0 All parameters of nominal accuracy
- 1 SFMR reduced sample
- 2 SFMR shallow water
- 3 SFMR reduced sample and shallow water

**\*If lat/lon questionable then ///**

# Discussion

- New processor greatly reduces number of SFMR questionable flags in HDOBs
  - Most data invalid flags from SFMR are a result of roll angle exceeded or over land
  - Significant reduction in RMS error threshold exceedance
- Goal of update to HDOB flag is to make SFMR flag more informative
  - Seeking feedback on proposed options or other suggestions
  - Earliest possible timeline for implementation is 2024 hurricane season
  - How will this impact HDOB users? Concerns?